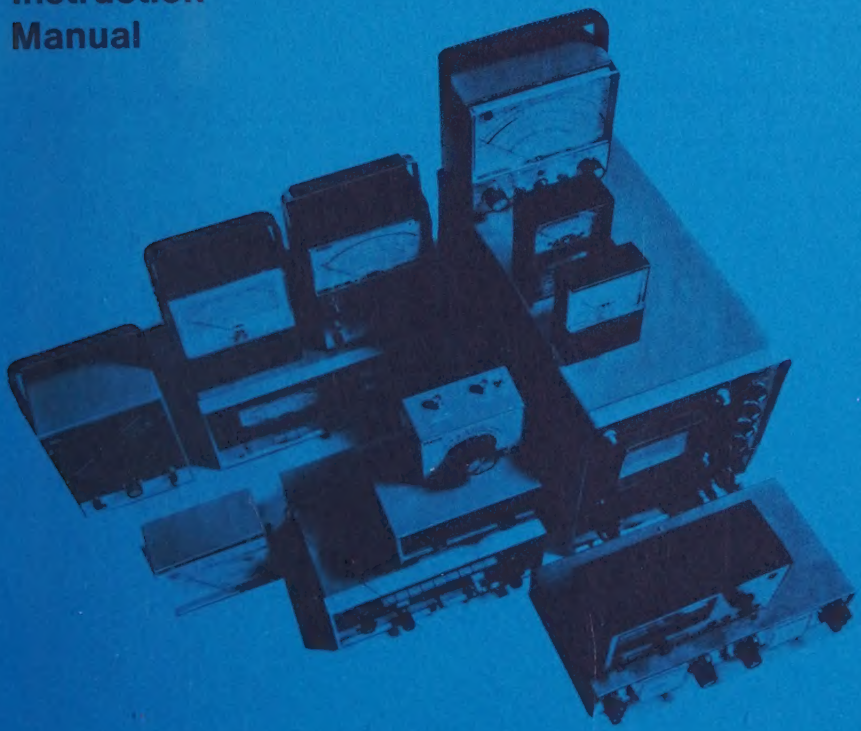
VoltOhmyst® V
WV-534A

Instruction Manual



VIZ Test Instruments

VIZ Mfg. Co. 335 E. Price St. Phila., Pa. 19144

Price $1.00

SAFETY PRECAUTIONS

Be careful whenever testing electrical equipment that is operating from an AC power line or other high voltage source. There is always the danger of electrical shock from these circuits. You should become familiar with the equipment before making tests. Keep in mind that voltages may appear at unexpected points in defective equipment.

It is good practice to remove power before connecting test leads to high voltage points. When measuring high AC or DC voltages, do not touch the panel or test leads. Also, it is important to use an isolation transformer such as the VIZ WP-25A, WP-26A, or WP-27A Isotap when working with AC/DC equipment where the chassis is connected to one side of the AC power line.

PATENT STATEMENT

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DESCRIPTION

The WV-534A, VoltOhmyst® V is an AC line, or battery operated portable electronic VoltOhm-Milliammeter which is especially useful in servicing solid-state equipment. The basic measuring circuit utilizes an FET (field-effect transistor) in a differential-amplifier circuit. The instrument has high input impedance, excellent stability and includes a number of design features which simplify making accurate and reliable in-circuit measurements. These features include a low-power resistance function and autopolarity on all DC voltage and current ranges.

The low-power resistance function limits both voltage and power supplied to the circuit under test so that solid-state devices will not conduct, assuring accurate resistance measurements. In addition, an ohms polarity-reversal switch is provided for convenient solid-state circuit testing. Ohms circuit polarity is shown on a separate polarity indicating meter on the front panel.

Autopolarity is provided for all DC voltage and current measurements; all readings are upscale regardless of the actual polarity of the voltage or current measured. Polarity is shown on a separate polarity-indicating meter on the front panel. This feature makes it unnecessary to switch functions or reconnect test leads to make positive or negative DC measurements.

The WV-534A measures AC and DC voltages from 0.001 volt (one millivolt) to 1500 volts in ten ranges; AC and DC current from 0.005μA (five microamperes) to 1.5 amperes in nine ranges; and resistance from 0.2 ohm to 1000 megohms in seven ranges, with either the normal or low-power ohms function. In addition, decibels from −50 dB to +56 dB can be measured with a standard reference of 0 dB equal to 1 mW into 600 ohms.

Both the FET circuit and the meter movement are protected to prevent damage due to accidental overload. The large, easy-to-read color-coded meter has a rugged taut-band, friction free movement and has a mirrored scale with the longest practical arc for greater ease in reading voltages and current. A single range selector combined with pushbutton function switches and a multifunction probe facilitates measurements. The VoltOhmyst® V is housed in a shielded case and comes complete with test leads, One type WG-475A AC/DC ohms probe and one set type WG-445A Test leads with banana plugs. The battery power supply requires eight 1.5 volt "AA" cells and one 1.5 volt "C" cell used in the resistance measuring circuit, which are not supplied.

NOTE:
For longer stable operation use Alkaline batteries. The WG-479 AC Adapter is available as an accessory, and replaces the eight 1.5 volt "AA" cells.

ACCESSORY ITEMS

Available Separately:
High Voltage Probe, WG-411A.
Multiplier Resistor, WG-206 – 1090 Megohms.

WG-479. AC Adapter supplied.

SPECIFICATIONS

Electrical	
DC Voltage	
Ranges	0 to 0.05, 0.15, 0.5, 1.5, 5, 15, 50, 150, 500, and 1500V
Input Resistance	10 Megohms (30 Megohms on 1500V range)
Accuracy	±3% of full scale reading
AC Voltage	
Ranges	0 to 0.05, 0.15, 0.5, 1.5, 5, 15, 50, 150, 500, and 1500V
Input Impedance	10 Megohms (30 Megohms on 1500V range)
Accuracy	±4% of full scale reading
DC Current	
Ranges	0 to 0.15, 0.5, 1.5, 5, 15, 50, 150, 500mA and 1.5A
Accuracy	±3% of full scale reading
AC Current	
Ranges	0 to 0.15, 0.5, 1.5, 5, 15, 50, 150, 500mA and 1.5A
Accuracy	±4% of full scale reading
Max Input Voltage	1500V AC, DC, or AC + DC
Resistance	
Ranges	Rx1, 10, 100, 1K, 10K, 100K, and 1 Megohm
Source voltage	Conventional 1.5V Low Power 50mV; 62.5 μW
Accuracy	±3% of scale length Center scale on Rx1 Range = 10 Ohms
Frequency Response	
Ranges	20Hz to 50KHz (±1 dB) 0.05 to 5.0V
Meter Movement	
90° Taut Band – 500 μA DC Full scale	
Batteries**	
Metering Circuit	Eight 1.5-volt "A" cells, (NEDA 15, 15F)
Ohms Circuit	One 1.5-volt "C" cells (NEDA 14F)
Mechanical	
Dimensions (less handle)	
Height	5 7/8 inches (14.9 cm)
Width	8 13/16 inches (22.4 cm)
Depth	5 inches (12.7 cm)
Weight (without batteries)	4 lbs, 12 oz. (2.15 kg)

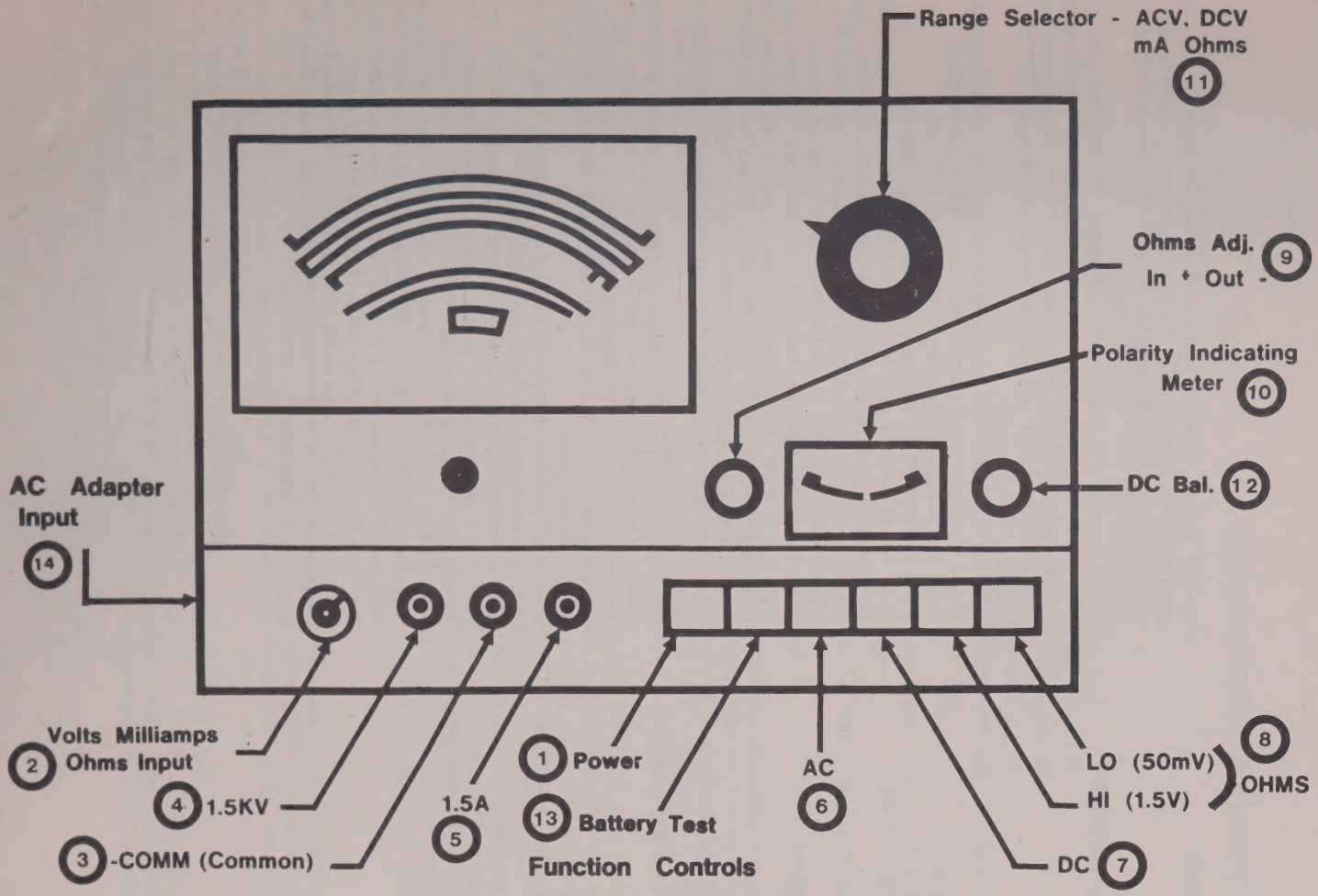

Figure 1. Operating Controls and Terminals.

OPERATIONG INSTRUCTIONS

PWR – On-Off switch. Press to apply power; switch locks in the "on" position. This switch must be in the depressed position for all measurement and adjustment functions. Press to release lock to turn instrument off.

V-mA-OHMS – Input terminal for measurements. Connect shielded test lead with BNC connector for voltage, current and resistance measurements. NOTE: Separate inputs are provided for voltage measurement from 500 to 1500 volts, and current measurement from 500 to 1.5 amperes.

–COM – Instrument ground and common return terminal for all measurements. Connect banana plug of black test lead to this terminal.

1.5 kV – Input terminal for voltage measurements to 1500 volts.

1.5 A – Input terminal for current measurements to 1.5 amperes.

AC V + mA – Press for AC voltage and current measurements. Used with Range Switch which must be set to select either a voltage or current range.

DC V + mA – Press for DC voltage and current measurements. Used with Range Switch which must be set to select either a voltage or current range.

OHMS – HI (1.5V) or LO (50mV). Press HI for conventional resistance measurements or press LO for measurements in solid-state circuits. Used with range switch which must be set to a resistance (OHMS-Rx) range. Use OHMS ADJ control to calibrate ohms scale.

OHMS = ∞ ADJ (IN +, OUT –) – Used to calibrate ohms scale. Pull control to reverse lead polarity on ohms function.

POLARITY METER – Indicates polarity of DC voltage, current, and resistance measurements. An upscale (pointer moves to the right of zero center) reading indicates "+"; downscale (pointer moves to the left of zero center) indicates "–". Also used with the DC BAL control to zero the calibrated meter.

RANGE SWITCH – Used with pushbutton function switches to select a range for voltage, current or resistance measurements.

DC BAL – Used to balance differential amplifier metering circuit.

BATT. TEST – Pushbutton function switch to test the instruments batteries.

AC ADAPTER INPUT – Preliminary Setup replaces the eight 1.5 volt "AA" cells. The WV-534A is a reliable measuring instrument which will provide accurate, repeatable measurements. Because it is designed to cover a wide range of measurement it incorporates a very sensitivie amplifier. To insure maximum accuracy, check the battery supply voltage once each day before the instrument is used, by depressing the Batt Test Pushbutton. The meter pointer should move to the "Batt. OK" area on the meter scale.

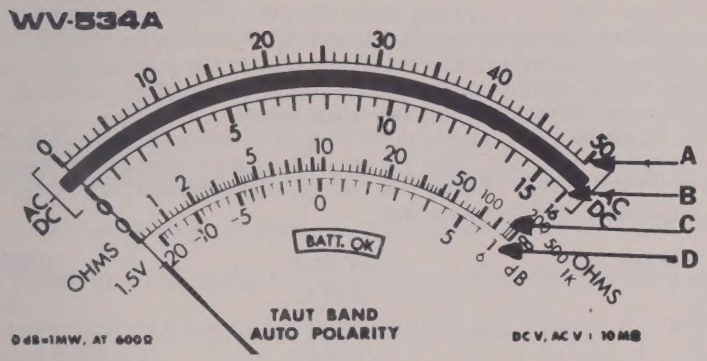

Figure 2. Location of Meter Scales.

Use of Color Coded Range Switch and Meter Scales. The WV-534A has a simplified range switch and meter scale which permits all voltage and current measurements to be made using only two scales (color coded Black, Fig. 2, A or B) The upper scale (A) is used with the Range Switch positions which are multiples of 0.05 such as ".5", "5", "50" and "500". The lower scale (B) is used with Range Switch positions which are multiples of 0.15 such as "1.5", "15", "150" and "1500".

Because of the wide number of measurement ranges provided on the WV-534A, it is often possible to take voltage or current reading on two ranges and scales. For greatest accuracy in voltage or current measurements, always use the range which will provide an on-scale reading which is nearest to the full-scale point. For example, 48 DC volts can be read from either the 50-volt or the 150-volt range. Because the 50-volt range will provide a reading nearest the full-scale point, the 50-volt range only should be used if a reading of best accuracy is to be obtained. This general rule applies to all meters because calibration is at full scale for AC and DC ranges.

All resistance measurements are made on a single scale (Color Coded Green, Fig. 2, C) using the multipliers on the Range Switch to determine the resistance. As in voltage or current measurements it is possible to make a resistance measurement on more than one position on the Range Switch.

AC- or DC-Voltage Measurements

Although the meter is protected against burn-out under ordinary overloads, it is good practice to make a trial measurement at a range setting *higher* than the voltage expected. Continued or repeated overloads may impair the accuracy of the movement. To measure AC or DC voltages, proceed as follows:

1. Press the "POWER" pushbutton switch to apply power.
2. Press either the "AC" or "DC" switch depending on the measurement to be made.
3. Connect the clip of the cable plugged into the "–COM" terminal to ground of the circuit under test. Because the instrument is isolated from the case it is possible to use a point other than ground. However, most schematics indicate voltages with respect to circuit ground, and it is good practice to use this common reference point.

4. Set the Range Switch to a position *higher* than the voltage to be measured. NOTE: For AC or DC voltages measurements above 500V, connect a test lead to the "1.5KV" input terminal. For AC or DC current measurements above 500mA connect a test lead to the "1.5A" terminal. The lead connected to the "–COM" terminal is used for all measurement functions.
5. Touch or connect the probe tip to the voltage source.
6. Reset the Range Switch to a position which gives a reading nearest to full scale.
7. Read the voltage from the Color Coded scale corresponding to the Range Switch setting as noted below. NOTE: When making DC voltage measurements, check the Polarity Meter to determine the polarity of the measurement.

AC or DC V Range	Use Scale	Multiply Reading By
0.05	0-50 A	.001
0.15	0-15 B	.01
0.5	0-50 A	.01
1.5	0-15 B	.1
5.0	0-50 A	.1
15	0-15 B	1
50	0-50 A	1
150	0-15 B	10
500	0-50 A	10
1500	0-15 B	100

THEORY OF OPERATION

The basic measurement circuit consists of a dual n-channel FET (FET 2) in a differential amplifier, and an integrated circuit operational amplifier (IC-1) which provides current feedback to FET-2. This feedback loop results in an extremely stable output which is linear with respect to the input. As a result only two linear scales are required for all voltage and current measurements. FET-1 is a diode-connected protective circuit for the amplifier.

The type of measurement is selected through pushbutton switch assembly SW-1 and through range switch SW-2. Resistors R4 – R17 and capacitors C1 – C9 are the frequ ncy com ensated attenuator network for the voltage ranges; R18 – R25 the input divider for the current ranges; and R26 – R31 the input divider for the resistance ranges.

The DC BAL control, VR-1 is used to balance the two sections of FET-2. In the balanced state no current flows, and there is no output from IC-1 and no deflection on the zero-center meter (M2) used for polarity indication. When a voltage is applied to either gate of FET-2 current flows in IC-1 and the direction is indicated on the polarity meter. The bridge rectifier composed of D1 – D4 permits either positive or negative current flow through separate legs and is connected to M1, the calibrated meter, through the "Power" switch so that all readings are upscale.

Conventional ohms measurements are made with a 1½-volt source. The direction of current flow in the test leads is changed by SWR-1, the ohms polarity switch. Normally this would result in an off-scale reading on the meter, but because of the autopolarity function all readings are upscale.

DC BALANCE

This procedure is used to balance the input amplifier and to compensate for possible changes in the power supply voltage.

1. Press the "PWR" pushbutton and the "DC" pushbutton.
2. Set the Range Switch to the any mmA position.
3. Adjust the "DC BAL" control to bring the Polarity meter pointer to zero (center).

RESISTANCE MEASUREMENTS

The WV-534A permits the selection of either a conventional- or low-power-resistance measurement. The low-power mode is used to prevent conduction when making measurements in equipment using solid-state devices with semiconductor characteristics. The low-power mode should also be used when making measurements of low-current, low-resistance components to minimize the possibility of damage.

NOTE: When making resistance measurements, be sure that power is off in the equipment under test.

1. Turn the instrument on and depress either the "HI" (conventional) or "LOW" (low-power) ohms pushbutton.
2. Set the Range Switch to the appropriate range as shown below. Separate the probe tip from the ground cable.
3. Adjust the "OHMS ADJ" to bring the needle of the calibrated meter to the "infinity" mark (Scale color coded green, C).
4. Connect the test leads across the resistance to be measured.
5. Read the resistance on the "OHMS" scale. Multiply the scale reading by the factor indicated on the Range Switch.

Checking Transistors:

Quick test for shorted or open transistors.

1. Set the range switch to Rx1K, and depress the "HI OHMS" function switch.
2. Connect the test leads to the transistor elements as shown in the figure. Measure the base-to-emitter resistance, then the base-to-collector resistance. Both readings should be about the same.
3. Reverse the ohms polarity by pulling out the "OHMS ADJ" knob. And, again measure the base-to-emitter, and base-to-collector resistance. These two measurements should also be about the same (but different from those obtained in Step 1).
4. The readings in Step 1 should be low (about 500 ohms) for one step, and high (about 500K ohms) for the other step, depending upon the polarity of the transistor (NPN or PNP). If any of the four individual measurements are radically incorrect, the transistor is bad.

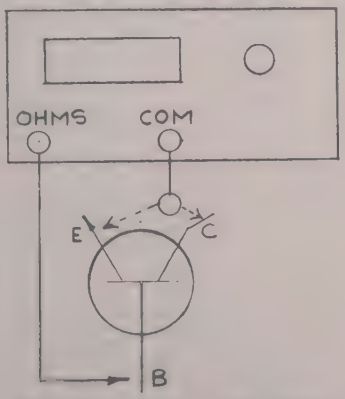

Figure 3: Test lead hookup, for testing transistors.

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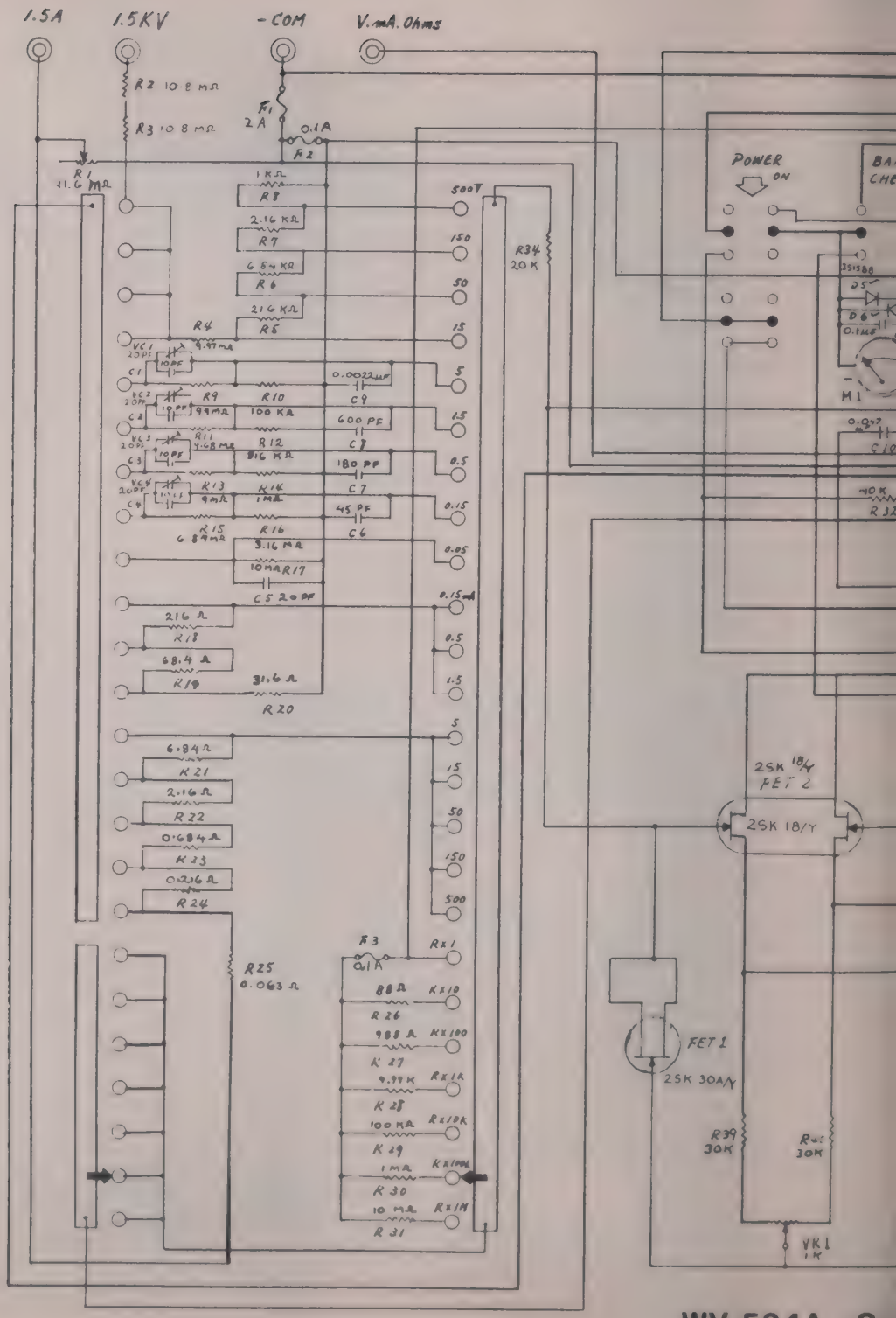
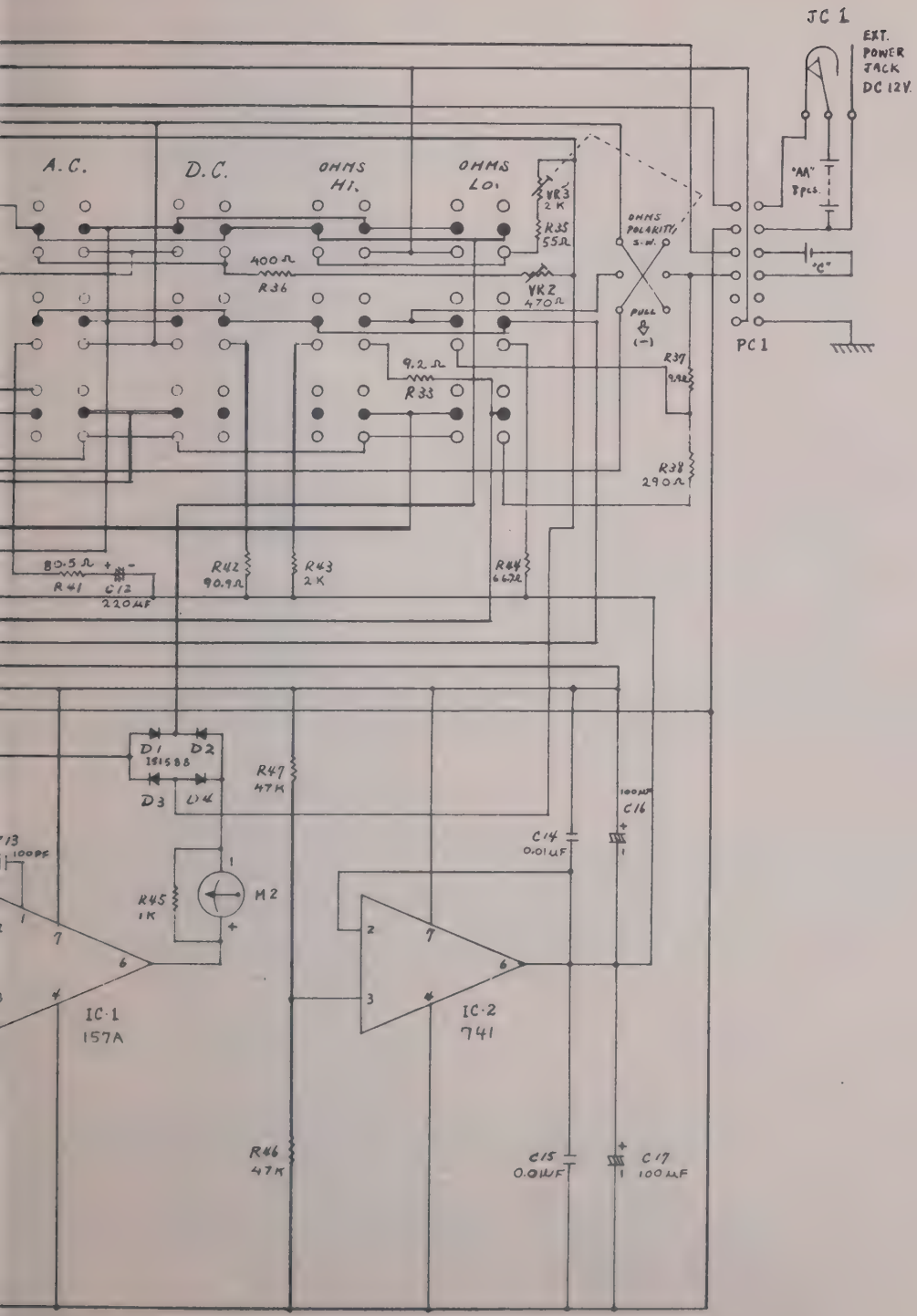

1.5A
1.5KV
-COM
V.mA.Ohms
R2 10.8 MΩ
R3 10.8 MΩ
F1 2A
0.1A F2
R1 21.6 MΩ
1 KΩ R8
2.16 KΩ R7
6.84 KΩ R6
21.6 KΩ R5
R4 9.99 MΩ
VC1 20PF 10PF C1
VC2 20PF 10PF R9 9.9 MΩ C2
VC3 20PF 10PF R11 9.68 MΩ C3
VC4 20PF 10PF R13 9 MΩ C4
R10 100 KΩ
R12 9.16 KΩ
R14 1 MΩ
R15 6.84 MΩ
R16 9.16 MΩ
10 MΩ R17
C5 20 PF
0.0022 μF C9
600 PF C8
180 PF C7
45 PF C6
216 Ω R18
68.4 Ω R19
31.6 Ω R20
6.84 Ω R21
2.16 Ω R22
0.684 Ω R23
0.216 Ω R24
R25 0.063 Ω
F3 0.1A
88 Ω R26
988 Ω R27
9.99 K R28
100 KΩ R29
1 MΩ R30
10 MΩ R31
500T
150
50
15
5
1.5
0.5
0.15
0.05
0.15mA
0.5
1.5
5
15
50
150
500
Rx1
Rx10
Rx100
Rx1K
Rx10K
Rx1M
R34 20 K
POWER ON
2SK 18/Y FET 2
2SK 18/Y
FET 1
2SK 30A/Y
R39 30K
30K
VR1 1K
M1
0.047 μF C10
40K R32

WV-534A Sc



atic Diagram

Checking Diodes:

1. Set the WV-534A to the HI Ohms function. Set the range switch to Rx1K, and adjust the Ohms Adj until the needle is set to the "infinity" mark.
2. Connect the test leads to the device.
3. Note the resistance on the meter.
4. Pull the "OHMS ADJ" control out to reverse the ohms circuit polarity and note the resistance.
5. One reading should be 500 ohms* or less, the other should be significantly higher.

* Some high-voltage diode have several diodes connected in series. These types may have higher foward resistance.

Checking Capacitors

The Rx10K resistance range, when used in the conventional "OHMS" mode, permits some indication of out-of-circuit capacitor DC leadkage resistance.

A good paper or mica capacitor under 1 μf will indicate near infinity (∞) after the initial surge required to charge the capacitor is completed. Leakage is indicated if the resistance is less than infinity. The time required to charge the capacitor will vary with the capacitance. The greater the capacitance, the more the pointer will swing and the longer it will take for it to return to infinity. If the capacitor is shorten, the pointer will not return to infinity, if the capacitor is open, there will be no initial pointer deflection. Very small capacitors will indicate only a slight deflection and a rapid return to infinity. Electrolytic capacitors, however, normally indicate some leakage after charging. The amount of leakage is generally related to the capacitance and voltage rating. For example, a low voltage, high capacitance unit will indicate more leakage (lower resistance) than a high-voltage, low capacitance unit. When testing an electrolytic capacitor, connect the probe tip to the positive terminal, and the lead connected to the "–COM" terminal to the negative terminal, of the capacitor.

Checking forward and Reverse Resistance of Semiconductor Devices:

A basic test for most semiconductor diode and discrete devices can be made by measuring the foward and reverse resistance of each junction. Because of the variety of transistor types and differences in construction, a specific forward-to-back resistance ratio can not be given. However, most junction devices should have a foward resistance of about 500 ohms or less. The reverse resistance should be significantly higher and can be as high as 1.5 megohms.

These values apply when the voltage source is 1.5 volts. Resistance may vary with other voltage sources. For a more significant test use a dynamic tester such as the VIZ WT-501A.

CURRENT MEASUREMENTS

1. Remove power from the circuit under test.
2. Connect the test leads in series with the test circuit. If necessary, open the circuit at a convenient point by disconnecting or unsoldering a wire or lead. Connect the test lead of the cable plugged into the "–COM" terminal to one end of the open circuit and the probe tip to the other end.
3. Set the Range Switch to a range *higher* than the current value expected.
4. Turn the instrument on and depress either the "AC" or "DC" pushbutton depending on the measurement to be made.
5. Apply power to the equipment under test.

6. Read the current on the meter scale (Color Coded Black) corresponding to the setting of the Range selector.
7. Note the polarity of DC current on the Polarity Indicating meter.

DECIBEL MEASUREMENTS

To measure dB, follow the procedure given for AC voltage measurements and read the dB value from the scale (Color coded Red, D). In some cases comparison to a standard is needed. This is easily done with the WV-534A because the dB scales are marked in DBM values. This value is defined as the number of decibels above or below a reference level of 1 milliwatt across a 600 ohm load. Zero DBM therefore indicates a power level of 1 milliwatt; 10 dbm, 10 milliwatts; and 20 dbm, 100 milliwatts, etc.

DBM values are read directly when the Range Switch is set to the 1.5-volt AC range. To use other ranges the values given below must be added or subtracted to the meter readings.

AC Voltage Range	For dBm values add or subtract
0.05	-30
0.15	-20
0.5	-10
1.5	0
5	+10
15	+20
50	+30
150	+40
500	+50

When relative dB measurements are made across loads other than 600 ohms, the actual numerical values are of no significance. However, the figures are helpful as a reference in determining the number of dB units between two readings on the dB scale. For example, if one reading is 20 dB and a second reading is 14 dB, this would indicate a power level variation of –6dB, regardless of the resistive load.

If an actual dbm value is needed the load resistance must be considered. For a load resistance other than 600 ohms, the correction factors given below must be added to the dbm value on the meter (if a range other than the 1.5 V range is used the corrections previously given must also be added or subtracted). Corrections to the value for resistive loads not given in the table may be calculated from the formula

$$\text{Correction Factor} = 10 \log \frac{600}{R}$$

where R is the load in ohms. If R is greater than 600 ohms the correction factor is negative and must be subtracted from the meter reading.

At 1000 Hz Resistive Load	DBM
600	0
500	+0.8
300	+3
250	+3.8
150	+6
50	+10.8
15	+16
8	+18.8
3.2	+22.7

FREQUENCY RESPONSE

Frequency response checks can be made on amplifiers, preamplifiers, tone-control circuits, and other audio equipment. An audio-frequency generator, such as the VIZ WA-504B/44D, is also needed to supply the input signal.

Three response checks at different power levels are recommended to obtain an accurate picture of response. The amplifiers should be checked at a low audible level, a moderate listening level, and at the maximum rated power level.

Note: In all measurements read from the decibel scale. (Color coded red) The figure shown on the selected Range Switch position must be added algebraically to the decibel scale indication.

1. Connect the equipment as shown in Figure 4. The WV-534A should be connected to the input of the amplifier each time the frequency of the input is changed. If necessary, adjust the output control of the audio generator to provide a constant input amplitude for all frequencies.

The resistive load connected across the amplifier output must be capable of dissipating the total power output of the amplifier. It is important that this resistor be of the non-inductive type so that its impedance will not vary with the frequency over the range being checked.

The oscilloscope shown in the figure is not absolutely necessary for the frequency response check, however, it is helpful in that it may reveal distortion in the output waveform. The output should be a good sine-wave if the frequency response measurement is to be valid.

2. Set the Range Switch to a position which will include the expected value of the voltage to be measured.
3. Set the amplifier volume control to the position which provides the output level at which the test is to be made. If the amplifier has tone-controls, set them to the "flat" position so that they have a minimum effect on the frequency of the amplifier. For determining the effect of the tone-controls, refer to the following section entitled "Tone Controls".
4. Adjust the generator to the desired reference frequency. The usual reference frequency is 1000 Hz.
5. Adjust the generator output control so that the WV-534A meter pointer indicates the desired reference level. Check the voltage at the input of the amplifier. It is important that the voltage of the input signal does not vary as the frequency is changed in the following steps. If it does, reset the output control of the generator so that the original input signal voltage is maintained.
6. Tune the audio generator to the lowest frequency to be measured. Record the db meter reading (number of db above or below the reference power level).
7. Tune the generator up to the next frequency to be measured.
8. Repeat the steps 3 through 7 for each power output level at which the frequency response check is to be made.

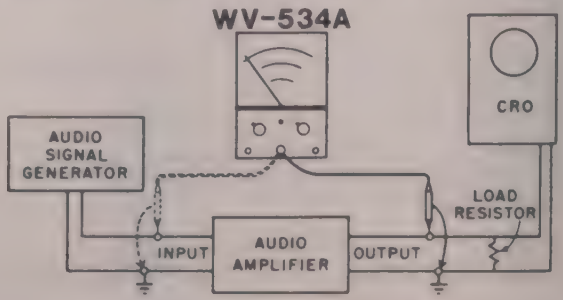


Figure 4. Test – setup for frequency-response measurements.

OVERLOAD (Momentary) CIRCUIT PROTECTION

Voltage ranges:	0.05 V range ..... Max 200V AC/DC 0.15 to 5V range ..... Max 500V AC/DC 15 to 1500V range ..... Max 1500V AC/DC
Currents:	0.15 to 1.5mA ..... Max. 100mA and 0.1A fuse 5mA to 1.5 Amps ..... Max. 2 amps and 2 amp fuse
Resistance:	Rx1 protected by 2 amp fuse Rx10 to rx1 meg. protected by 0.1 amp fuse max input voltage 200V AC/DC

FUSE REPLACEMENT

Three fuses are used, in addition to other protective circuits. F1 (2 amps), F2 and F3 (.1 amp). If fuse replacement becomes necessary, replace only with a fuse having the same ratings.

BATTERY INSTALLATION

Batteries are housed in a set of battery holders located just inside the back cover. The hinged back of the instrument can be opened by pulling on the two knobs located in the upper corners of the back.

The upper battery holder contains one C size cell used in the ohms measurement circuit. The lower battery holder which is removeable holds 8 "AA" size cells. Be sure to observe the correct polarity when installing batteries.

ANTI-STATIC METER COATING

The clear meter cover of this instrument has been coated with a special anti-static solution to prevent static effects on the action of the pointer. Eventually this coating may lose its effectivness, and a static charge will build up on the meter case causing the pointer to act erratically. You can check this anti-static characteristic by rubbing the meter cover with a clean soft cloth. If the anti-static coating is no longer effective, the meter pointer will move off zero and remain there for several minutes.

If necessary, a new coat of anti-static solution should be applied to the outside of the meter "window". A small bottle of this solution can be purchased from most local electronic distributors.

VIZ REPAIR SERVICE

Authorized VIZ Service Depots throughout the United States are available for repair and calibration of VIZ Electronic Instruments. For up-to-date listings of these depots, contact your VIZ Distributor, or write to VIZ, Electronic Instruments, 335 E. Price St., Phila. Pa., 19144. If it becomes necessary to service this equipment, fill out the Test Equipment Service order form supplied with the instructions:

1. Pack the test equipment carefully. The instrument should be doubled-packed. It is best to pack the unit in its original carton, or similar container, then "float" this carton in at least a 3-inch layer of suitable packing, such as shredded paper, inside the outer carton.
2. A full description of the problem should be included in the request.
3. Include all probes, cables, and test leads used with equipment.
   Attention to these details will help prevent damage in transit and delay in repairs.

REPLACEMENT PART POLICY

It is VIZ's policy to make replacement parts available to its customers at the least cost and as quickly as possible. All items where a part number is listed in BOLD FACE are available from your local VIZ Distributor. Please use the VIZ part number when ordering.

REPLACEMENT PARTS LIST

SYMBOL NO.	DESCRIPTION	STOCK NO.
C	CAPACITORS	
C1	Type, Value, Tolerance	9xxx-xxx
C2	Type, Value, Tolerance	xxxxxx
	RESISTORS	
R1	Value, Tolerance	9xxx-xxx
R2	Special if Propertie any, Value, Tolerance	xxxxxx
R3	any, Value, Tolerance	16-xxxxxx
	MISCELLANEOUS	
S1	Switch, Type	9xxx-xxx

All other items listed are standard parts available at most Electronic Distributors. Please order these parts by the description as listed, from your distributor.

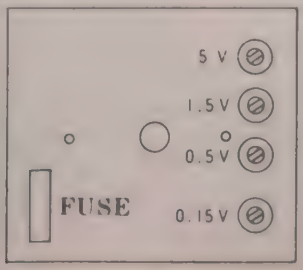
CALIBRATION

To correct any sensitivity error caused through repair or long period of use: Apply a standard voltage and adjust the variable resistance next to the 2A fuse till the pointer indicates the correct value.

To correct the frequency characteristic error: Apply 100Hz, 1KHz and 10KHz sine wave and adjust the variable condenser on the PC Board so that sensitivity doesn't change by changing the frequency.

If an oscilloscope is available, apply 1KHz rectangular wave and adjust the variable condenser, checking the wave form of the gate of FET (IC side) so that the wave form has a similar form to the Input wave.

The location of the variable condensers for each is shown below.



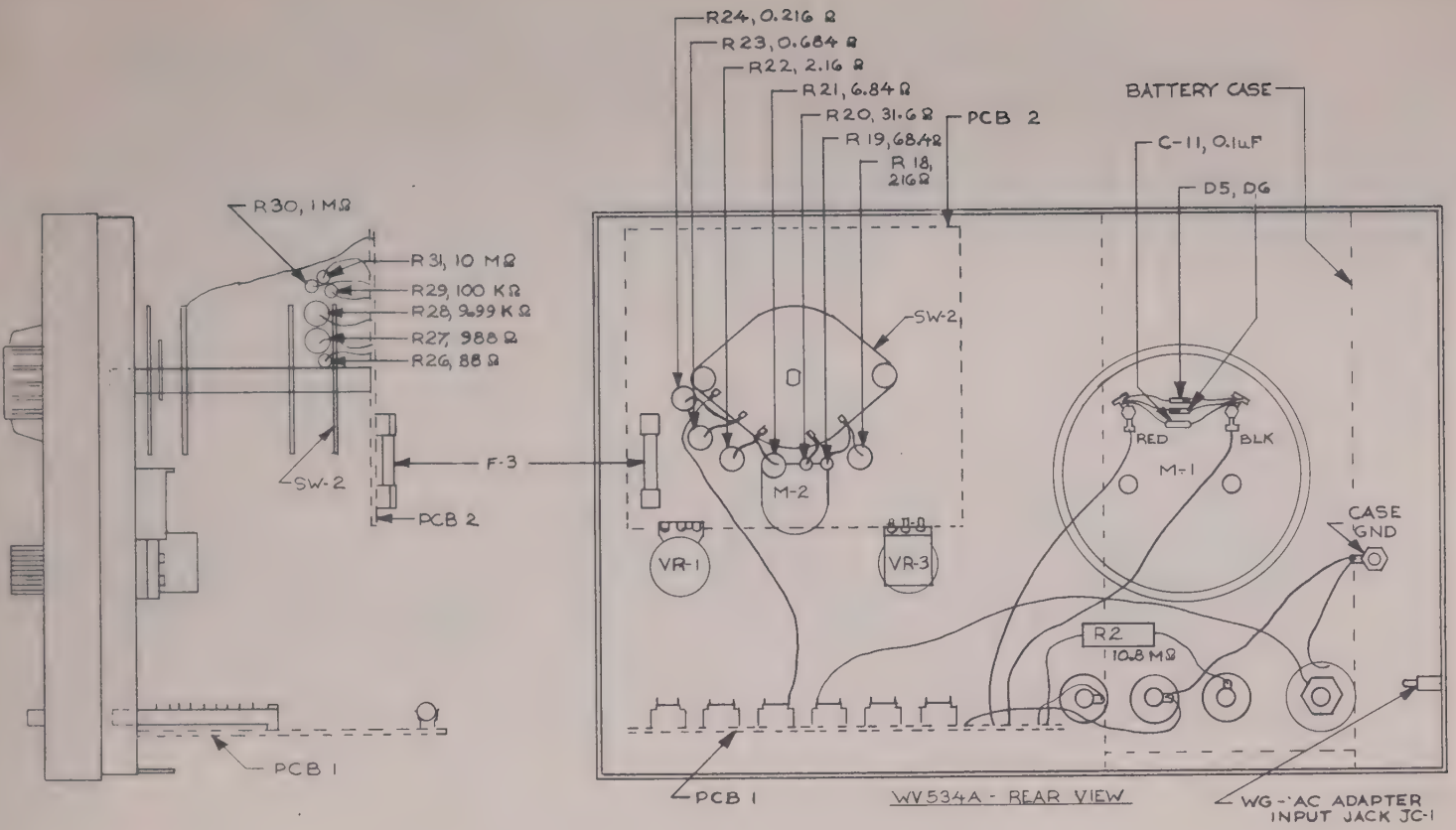


Figure 5. Replacement parts location.

SYMBOL	DESCRIPTION		PART NO.
M-1	Meter (Model U-120 500uA dc 55 ohms) Includes: scale-plate, back-case & F-cover		* 9134-1
SC-1	Scale plate only for meter.		* 9134-2
MC-1	Meter F-cover w/zero adj. (clear plastic)		* 9134-3
MB-1	Meter back case w/assembled. (ABS plastic)		* 9134-4
M-2	Indicator (Model TB-30 ±100uA dc 1200 ohms)		* 9134-5
SC-2	Scale plate only for TB-30.		* 9134-6
MC-2	Meter cover for TB-30.		* 9134-7
MB-2	Meter case for TB-30.		* 9134-8
FP-1	Front panel plate (ABS) with aluminum range plate.		* 9134-9
ALP-1	Aluminum range plate only.		* 9134-10
BC-1	Back case with handle & name plate.		* 9134-11
HAN-1	Handle (vinyl) only.		* 9134-12
ALP-2	Name plate.		* 9134-13
SW-1	Push button switch one set w/plastic cover which is Red-1, White-1 & Black-4pcs.		* 9134-14
SW-2	Rotary switch (3-2-24 positions)		* 9134-15
SWR-1	Polarity switch w/2K ohms VR-resistor		* 9134-16
JC-1	Power jack for AC line.		* 9134-17
BNC-1	BNC connector w/plug receptacle		9134-18
BC-2	Battery case for type "C" cell.		9134-19
BC-3	Battery case for type "AA" cell.		9134-20
BC03	Battery connector.		9134-21
KB-1	Rotary switch knob.		9134-22
KB-2	Polairyt switch & DC balance knobs.		* 9134-23
PC-1	Pin connector (plug & jack) horizontal 6 pins		* 9134-24
PCB-1	Printed circuit board for push button sw.		* 9134-25
PCB-2	Printed Circuit board for rotary switch		* 9134-26
FH-1	Fuse holder for glass fuse		9134-27
HWS-1	Hardware set for fuse holder		9134-28
TM-1	Terminal of shunt-resistor		* 9134-29
HWS-2	Hardware set for TM-1		9134-30
F-1	2 Amps glass fuse		9134-31
F-2-3	0.1 Amp glass fuse		9134-32
D-1 to D-4	Silicon diode (IS1588) AC rectifier		9134-33
D-5 to D-6	Silicon diode (IS1588) M-movement protection		9134-33
FET-1	Fet diode (2SK-30A Y-rank) FET protection		9134-35
FET-2	FET diode (2SK-18 Y-rank) Dual FET		9134-36
IC-1	IC UPC-157A		9134-37
IC-2	IC UA-741		9134-38
Capacitors			
C-1-2-3-4	Ceramic capacitor	10pF 500V	17-110100
C-5	Ceramic capacitor	20pF 500V	17-120200
C-6	Ceramic condenser	45pF 50V	17-145450
C-7	Ceramic capacitor	180pF 50V	17-218180
C-8	Ceramic capacitor	600pF 50V	17-260600
C-9	Film capacitor	0.0022uF 50V	9134-44
C-10	Film capacitor	0.047uF 50V	9134-45
C-11	Film capacitor	0.1uF 50V	9134-46
C-12	Electrolytic capacitor	220uF 25V	9134-47
C-13	Ceramic capacitor	100pF 50V	17-210100
C-14-15	Ceramic capacitor	0.01uF 50V	9134-49
C-16-17	Electrolytic capacitor	100uF 25V	9134-50
VC-1 to 4	Variable ceramic capacitor	20pF	9134-51
Accessories			
A-1	Test lead (color red) use 1.5 Amps & 1.5K V		9134-52
A-2	Test lead (color black) use for comm jack		9134-53
A-3	Instruction manual		9134-54
A-4	Warranty card, Service form, Post card		9134-55
A-5	Display box		9134-56
A-6	Spare fuse: 2pcs for 0.1 Amp. & 2pcs 2 Amps		9134-57

SYMBOL				DESCRIPTION	PART NO.
R-1	(mw)	31.6	mΩ	Manganese wire 1%	* 9134-58
R-2-3	(mf)	10.8	MΩ	1 watt P-type 1% resistor	* 9134-59
R-4	(mf)	9.97	MΩ	1 watt P-type 1% resistor	* 9134-60
R-5	(cf)	21.6	KΩ	1/2 watt P-type 1% resistor	16-552160
R-6	(cf)	6.84	KΩ	1/2 watt P-type 1% resistor	16-546840
R-7	(cf)	2.16	KΩ	1/2 watt P-type 1% resistor	16-542160
R-8	(cf)	1	KΩ	1/2 watt P-type 1% resistor	16-541000
R-9	(mf)	9.9	MΩ	1/2 watt P-type 1% resistor	16-579900
R-10	(cf)	100	KΩ	1/2 watt P-type 1% resistor	16-56100
R-29					
R-11	(mf)	9.68	MΩ	1/2 watt P-type 1% resistor	16-579680
R-12	(cf)	316	KΩ	1/2 watt P-type 1% resistor	16-563160
R-13	(mf)	9	MΩ	1/2 watt P-type 1% resistor	16-579000
R-14	(cf)	1	MΩ	1/2 watt P-type 1% resistor	16-571000
R-30					
R-15	(mf)	6.84	MΩ	1/2 watt P-type 1% resistor	16-576840
R-16	(mf)	3.16	MΩ	1/2 watt P-type 1% resistor	16-173160
R-17	(mf)	10	MΩ	1/2 watt P-type 1% resistor	16-581000
R-31					
R-18	(cf)	216	Ω	1/2 watt P-type 1% resistor	16-532160
R-19	(cf)	68.4	Ω	1/2 watt P-type 1% resistor	16-526840
R-20	(cf)	31.6	Ω	1/2 watt P-type 1% resistor	16-522160
R-21	(mw)	6.84	Ω	1/2 watt wired 1% resistor	* 9134-77
R-22	(mw)	2.16	Ω	1/2 watt wired 1% resistor	* 9134-78
R-23	(mw)	0.684	Ω	1/2 watt wired 1% resistor	* 9134-79
R-24	(mw)	0.216	Ω	1/2 watt wired 1% resistor	* 9134-80
R-25	(mw)	0.063	Ω	3/4 watt wired 1% resistor	* 9134-81
R-26	(cf)	88	Ω	1/2 watt P-type 1% resistor	16-528800
R-27	(mf)	988	Ω	1/2 watt P-type 1% resistor	16-539880
R-28	(cf)	9.99	K	1/2 watt P-type 1% resistor	16-549990
R-32	(cf)	40	K	1/4 watt P-type 5% resistor	16-164030
R-33	(mw)	9.2	Ω	1/2 watt wired 1% resistor	* 9134-86
R-34	(cf)	20	K	1/2 watt P-type 5% resistor	16-222030
R-35	(cf)	55	Ω	1/4 watt P-type 5% resistor	16-165500
R-36	(cf)	400	Ω	1/4 watt P-type 5% resistor	16-164010
R-37	(mw)	9.9	Ω	1/2 watt wired 1% resistor	* 9134-90
R-38	(cf)	290	Ω	1/4 watt P-type 1% resistor	16-532900
R-39	(cf)	30	K	1/4 watt P-type 5% resistor	16-163030
R-40					
R-41	(cf)	80.5	Ω	1/4 watt P-type 1% resistor	16-528050
R-42	(cf)	90.9	Ω	1/4 watt P-type 1% resistor	16-529090
R-43	(cf)	2	K	1/4 watt P-type 1% resistor	16-542000
R-44	(cf)	66.7	Ω	1/4 watt P-type 1% resistor	16-526670
R-45	(cf)	1	K	1/4 watt P-type 5% resistor	16-161020
R-46	(cf)	47	K	1/4 watt P-type 5% resistor	16-164730
R-47					
VR-1	(cf)	1	K	Variable resistor	* 9134-99
VR-2	(cf)	470	Ω	Semi-variable resistor	* 9134-100
VR-3	(cf)	2	K	Variable resistor	* 9134-101

* Re: Above (mf) = Metal Film, (cf) – Carbon Film & (mw) – Manganese Wired

Figure 5. Replacement parts location.

THIS BOOK BELONGS TO:

NOTES:

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